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Proceedings of the Regional Peer Review of the Assessment of Arctic Surfclam (*Mactromeris polynyma*) Stock on Banquereau

April 20-21, 2017
Dartmouth, Nova Scotia

Chairperson: Tana Worcester
Editor: Lottie Bennett

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Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

A regional peer review meeting was held on April 20-21, 2017, at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia to assess the stock status of Arctic Surfclam on Banquereau and to provide management advice in a manner consistent with the Fisheries and Oceans Canada (DFO) precautionary approach. As set out in the Terms of Reference, the focus of the meeting was to assess current stock status of the total fished area and the five proposed assessment areas on Banquereau, evaluate reference points to be used in future stock assessments and updates of Surfclam on Banquereau, review available information on habitat suitability, and provide management advice. Participation in this meeting included DFO Science and Resource Management, First Nations and Aboriginal organizations, the fishing industry, and non-DFO scientists.

The Arctic Surfclam fishery in the Canadian Atlantic operates on both the Scotian Shelf and the Grand Banks, with effort concentrated on Banquereau during 2006-2015, and both banks fully harvested in 2016. The Grand Bank and Banquereau Arctic Surfclam stock was last assessed in 2010 and 2011 (Roddick et al. 2011, 2012) using an assessment framework developed for Banquereau and Sable banks in 2007 (DFO 2007). In 2016, a fisheries-dependent assessment methodology was developed for Banquereau using a spatially disaggregated surplus production model (Hubley and Heaslip 2016). Given that there has been relatively little fishing activity on Grand Bank since the time of the last assessment in 2010, a full analysis can only be conducted for Banquereau at this time.

On Banquereau, high resolution Vessel Monitoring System (VMS) data was used to estimate the fishery footprint, which served as a proxy for habitat suitability data. Modelled biomass estimates are only provided for the fished area portion of the Bank, which is divided into five spatial assessment areas. Maximum sustainable yield reference points pertaining to fished areas were calculated from the surplus production model with F_{MSY} estimates near 0.09; however, phase plots indicate that catch rates decline when F is greater than $0.5F_{MSY}$. A removal reference of $0.5F_{MSY}$ and continued use of the current trigger level reference point of $CPUE_{70}$ was proposed. The Banquereau stock is considered healthy as modelled biomass estimates are above the biomass reference levels for all five assessment areas.

This proceedings document includes a summary of the presentation and is a record of the meeting discussions and conclusions. A Science Advisory Report and a Research Document resulting from this meeting will be published on the Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat's (CSAS) Website as they become available.

Compte rendu de l'examen régional par les pairs de l'évaluation du stock de mactre de Stimpson (*Mactromeris polynyma*) sur le Banquereau

SOMMAIRE

Une réunion régionale d'examen par les pairs a eu lieu les 20 et 21 avril 2017 à l'Institut océanographique de Bedford, à Dartmouth (Nouvelle-Écosse), en vue d'évaluer l'état du stock de mactre de Stimpson sur le Banquereau et de fournir un avis de gestion conforme à l'approche de précaution de Pêches et Océans Canada (MPO). Conformément au cadre de référence, la réunion avait pour objet d'évaluer l'état du stock actuel de la zone de récolte totale et des cinq zones d'évaluation proposées sur le Banquereau; d'évaluer les points de référence à utiliser dans les futures évaluations du stock et les mises à jour sur le stock de mactre de Stimpson sur le Banquereau; d'examiner l'information disponible sur l'adéquation de l'habitat; et de fournir un avis de gestion. Les participants à cette réunion comprenaient des représentants des Secteurs des sciences et de la Gestion des ressources du MPO, des Premières Nations, de l'industrie de la pêche ainsi que des scientifiques qui ne travaillent pas pour le MPO.

La pêche de la mactre de Stimpson dans les eaux canadiennes de l'Atlantique se déroule sur la plate-forme Néo-Écossaise et les Grands Bancs, les efforts s'étant particulièrement concentrés sur le Banquereau de 2006 à 2015 et les deux bancs ayant été pleinement récoltés en 2016. La dernière évaluation du stock de mactre de Stimpson du Grand Banc et du Banquereau remonte à 2010 et 2011 (Roddick et al. 2011, 2012); elle avait été effectuée selon un cadre d'évaluation élaboré pour le Banquereau et le banc de l'île de Sable en 2007 (MPO 2007). En 2016, une méthode d'évaluation dépendante de la pêche a été mise au point pour le Banquereau à l'aide d'un modèle de production excédentaire désagrégée sur le plan spatial (Hubley et Heaslip 2016). Dans la mesure où l'activité de pêche pratiquée sur le Grand Banc a été relativement très limitée depuis la dernière évaluation de 2010, une analyse complète peut être réalisée pour le Banquereau cette fois.

On a utilisé les données d'un système de surveillance des navires (SSV) à haute résolution pour estimer l'empreinte de la pêche sur le Banquereau, qui a servi de valeur approximative pour les données sur l'adéquation de l'habitat. Les estimations modélisées de la biomasse ne sont fournies que pour la partie récoltée du Banc, qui est divisée en cinq zones d'évaluation spatiales. Les points de référence du rendement maximal soutenu relatifs aux zones de récolte ont été calculés à l'aide du modèle de production excédentaire, avec des estimations de F_{MSY} proches de 0,09; cependant, les diagrammes de phase montrent que les taux de prise diminuent lorsque la valeur de F est supérieure à 0,5 F_{MSY}. On a proposé une référence de prélèvement de 0,5 F_{MSY} et de continuer à utiliser l'actuel point de référence pour le niveau de déclenchement de $CPUE_{70}$. Le stock du Banquereau est considéré comme se trouvant dans la zone saine puisque les estimations modélisées de la biomasse sont supérieures aux niveaux de référence de la biomasse pour les cinq zones d'évaluation.

Le présent document inclut un résumé de la présentation et est un compte rendu des discussions et des conclusions de la réunion. Un avis scientifique et un document de recherche découlant de cette réunion seront publiés sur le site Web du Secrétariat canadien de consultation scientifique lorsqu'ils seront disponibles.

INTRODUCTION

The Arctic Surfclam (*Mactromeris polynyma*) is a slow growing long-lived species found primarily in coarse sandy bottoms. In the western Atlantic, they occur from the Strait of Belle Isle to Rhode Island. The Arctic Surfclam fishery in the Canadian Atlantic operates on both the Scotian Shelf and the Grand Banks, with primary focus on Banquereau in recent years. The Scotian Shelf and Grand Banks offshore clam fisheries are managed under one plan, with the licence holder(s) having equal access to quotas in both areas through Enterprise Allocations.

Science surveys of Banquereau Arctic Surfclams were conducted in 2004 and 2010. Due to the large size of the Grand Bank, a scientific survey of Grand Bank Arctic Surfclam was conducted in three parts ending in 2009 (2006, 2008 and 2009) to assess the biomass of the stock in this area. A peer reviewed stock assessment of Grand Bank Arctic Surfclam was conducted in 2010 (DFO 2010), using an assessment approach similar to that developed for Banquereau.

The Banquereau Arctic Surfclam stock was last assessed in 2011 (DFO 2012). An assessment framework for Arctic Surfclam on Banquereau and Sable banks was developed in 2007 (DFO 2007) and the methods of assessment for Banquereau were revised in 2016. A surplus production model and spatially disaggregated analysis was accepted as the new assessment approach at the 2016 assessment framework meeting (DFO 2016).

As part of the Regional Peer Review process, a meeting was held on April 20-21, 2017, at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia, to assess the stock status of Arctic Surfclam on Banquereau and to provide management advice in a manner consistent with the Fisheries and Oceans Canada (DFO) precautionary approach.

The meeting Chairperson, Tana Worcester, introduced herself, followed by an introduction of meeting participants (Appendix 1). The Chair thanked meeting participants for attending the DFO Regional Peer Review Process. The Chair provided a brief overview of the Canadian Science Advisory Secretariat (CSAS) peer review process and invited participants to review the meeting Terms of Reference (Appendix 2) and Agenda (Appendix 3). This Proceedings report is the record of the discussion of the meeting.

To guide discussions, a working paper had been prepared, which would be produced as a Research Document upon review and acceptance. The meeting Chair noted that the working paper was not to be used in any other forum, distributed, or cited. A Science Advisory Report (SAR) was also produced as a result of this meeting.

Participants expressed concern that the meeting documentation was not distributed in a timely manner to ensure a thorough review prior to the meeting. Updated documentation from the Arctic Surfclam framework peer review was provided to meeting participants prior to the meeting, and a working paper with the data points for 2016, was circulated the day before. Future efforts will be made to ensure appropriate documents are made available to participants in an appropriate time frame.

Due to *Privacy Act* considerations, some of the information presented during the meeting was not available for general distribution; however, meeting participants identified as peer reviewers did have access to all data and information for review prior to the meeting. Participants expressed concern that this did not permit the peer-review process to be fully informed and transparent. It was noted that while the results from several components of the review are confidential and are absent from the working paper, this meeting is as inclusive and transparent as possible. The Licence holder consented to the release of information that was critical to the understanding of the status of the resource.

There were questions about the difference between the science peer review process, which is not considered to be consultation, and consultation. It was recommended that these terms be more clearly defined.

PRESENTATIONS AND DISCUSSIONS

SPATIAL DISTRIBUTION, HISTORY OF ARCTIC SURFCLAM FISHERY SURVEY AND ASSESSMENT HISTORY, AND ARCTIC SURFCLAM LIFE HISTORY

Working Paper: Hubley et al. 2017. Assessment of the Arctic Surfclam (*Mactromerus polynyma*) stocks on Banquereau and Grand Banks. CSAM Working Paper 2017/04.

Science Leads: Brad Hubley, Susan Heaslip, and Ryan Stanley
Rapporteur: L. Bennett

Presentation Summary

Background and contextual information were presented on the history of the fishery on Banquereau and Grand Banks and the life history of the Arctic Surfclam. Ecosystem considerations, such as the impacts of dredging were discussed. The disturbance caused by the use of bottom contact gear has an immediate impact on the substrate and benthic organisms; however, the impact of the fishery is relatively lower than other bottom contact gear due largely to its relatively small footprint. The results of the secondary indicators report, which outlines the relative status of three indicators Catch per Unit Effort (CPUE), the spatial extent or footprint of the fishery, and the abundance of older/larger clams in the catch relative to established trigger levels and thresholds, was presented with data from 2016. For both Banquereau and Grand Bank, CPUE and the fished abundance of large clams were above trigger levels and the spatial extent of the fishery was below the threshold.

The last Arctic Surfclam survey was in 2010, and since 2007 fishing activity has occurred almost exclusively on Banquereau with little effort directed towards Grand Bank; however, both banks were fully harvested in 2016. The last survey on Banquereau in 2010 produced a bank-wide biomass estimate. This estimate is the result of extrapolation to the entire bank, for which much of the associated uncertainty was not captured in the previous estimates of abundance. For this assessment, five spatial assessment areas that represent the fished area were defined by Vessel Monitoring System (VMS) location data to facilitate a biomass modelling analysis. Data inputs for the assessment were discussed in detail: catch, effort, CPUE, location, Vessel Monitoring System (VMS) data, and previous survey data. Since the 2010 survey, the CPUE index, which is derived from the commercial fishery information, is the only new information to inform the current status of the fished biomass. Fishery data is used with caution given the inherent issues with using commercial catch rates. The Spatial Production Model biomass estimates for each assessment area showed a similar trend, with biomass increases in the early 2000s followed by declines since 2010. Exploitation rates have varied as the fishery shifted its focus between areas. Exploitation rates were high in Area 5 in 2016 as catches have remained high and catch rates have declined.

The Banquereau stock is considered to be in the Healthy Zone, as the modelled biomass estimates are above biomass reference levels for each proposed assessment area. The risk associated with exploitation levels applied to biomass estimates based on different assessment areas (e.g., bank-wide vs. fished area) was presented.

Discussion

Background and Life History

The reported global distribution of Arctic Surfclam is in deep water of both the northern North Pacific and the northwestern Atlantic oceans. A species that is indistinguishable from Arctic Surfclam has been recorded in North Korea but meeting participants suggest/suspect that the habitat range of Arctic Surfclam does not extend to Japan.

Participants asked if observer data is proprietary information. The assessment leads indicated they would check with the Regional Manager of Access to Information and Privacy to determine whether the information can be distributed.

Secondary Indicators Report-Status of the Fishery

There was a discussion on the three indicators used to monitor the fishery: CPUE; the spatial extent or footprint of the fishery; and the abundance of older/larger clams at fished locations. It was asked whether directed fishing activity in low density areas would trigger an assessment or management action. As with the other two indicators, the fishery footprint serves as an alert to changes in the fishery and is used to provide an evaluation of stock status relative to limit reference points within the assessment areas.

Estimates of gear efficiency continue to be a source of uncertainty that requires further study. The fishery harvests clams with an optimal size structure and does not catch smaller clams. A dredge efficiency experiment during the 2010 Surfclam survey estimated an efficiency of 0.45 (45%); however, due to large confidence intervals, the estimated range of efficiency was 30-90%. The current efficiency estimate is 0.39 (39%). Reports of a 90% efficiency rate quoted from the literature were derived from visual surveys of a dredge and were not specific to this circumstance.

There was a lengthy discussion on using the fishery footprint as a proxy for habitat suitability to estimate biomass in the fished portion of the Bank. Due to the patchy nature of Arctic Surfclam distribution and the lack of habitat information, high resolution VMS data was used as a proxy for clam habitat on the fished portion of Banquereau Bank. The majority of fishing effort has concentrated on an area of approximately 20% of the bank and it is assumed that the fishery has targeted all areas with fishable concentrations over the past 12 years. Participants expressed concern with estimating biomass based on a footprint established by industry as large portions of the Bank have never been fished. There are a variety of factors unrelated to changes in stock biomass that could contribute to changes in a fishing footprint (e.g. fishing for multiple species, fishing in new areas) and affect catch per unit effort and biomass estimates. Examples of similar approaches that have been used in other sessile bivalve fisheries where fishing effort is concentrated in the most productive areas were discussed.

There have been no new fishery independent surveys since the last assessment and survey were completed in 2010; therefore, CPUE is the only source of information in regards to current stock status. Concerns with the use of CPUE data to estimate biomass include the over or under estimation of biomass due to changes in the fishery footprint as a result of changing efficiency from gear modifications over time, habitat mapping efforts, a fishing strategy that directs fishing for multiple species, or unaccounted biomass that occurs outside of fished locations. Industry acknowledged that gear modification and habitat suitability data has increased efficiency, and it will be difficult to quantify changes in catchability or develop an index of efficiency changes. Catch and effort data will continue to be used to estimate stock status until a longer time series of data from fishery independent surveys are available to provide a bank wide biomass estimate. The need for a fishery independent survey was reiterated throughout the meeting.

The analysis of VMS data for identifying fishable clam habitat was discussed. VMS density was estimated using a kernel smoothed intensity function and is expressed as the number of transmissions per km^2. A density level of 30 transmissions per km^2 was chosen to define the fished area. Only data with corresponding logbook catch and effort data was used in the analysis. A bandwidth of 0.2 was selected for the kernel density analysis as it best characterized what was seen in the raw data. It was suggested that a qualitative approach, such as an autocorrelation analysis, be used to determine the optimal bandwidth. Given the similarity to the approach used in the Inshore Bay of Fundy Scallop assessment, it was suggested that the Inshore Bay of Fundy Scallop survey be reviewed to determine how the bandwidth was selected for the analysis. Since the estimated area of viable clam habitat is sensitive to the density threshold, an analysis comparing high resolution habitat suitability models to refine or corroborate this threshold was also recommended. It was noted that an analysis showing the effects of a range of thresholds on the estimation of fished areas presented at the Arctic Surfclam Framework review indicated that thresholds between >20 and <40 VMS data points (transmissions per km^2) should be used to identify the fished areas.

Biomass Estimates and Spatial Management Areas

Bank wide or total biomass estimates were not calculated for this assessment. Biomass estimates have only been provided for the fished areas of Banquereau Bank. There was considerable discussion concerning the methods used to estimate clam biomass as well as the methods used during previous Arctic Surfclam surveys and the usability of results from a 2010 fishery independent survey to estimate biomass in the unfished portion of Banquereau. A proposal was made by a meeting participant to subtract the biomass estimated from the Spatial Production Model (SPM) for the fished areas from the total biomass estimate of the 2010 survey. Trend analysis of survey data from Banquereau are made difficult by vessel and gear changes between the 2004 and 2010 surveys. In addition, the analysis and extrapolation used to calculate the bank-wide biomass estimate of approximately 800,000 tonnes from the 2010 survey did not include uncertainties related to dredge efficiency, gear selectivity, or the patchy distribution of clams across the Bank. It was recommended that additional information on the assumptions used in the analysis of the 2010 survey data be provided. While meeting participants acknowledged there are likely areas of suitable habitat outside of currently fished areas, consensus was not reached on the use of previous survey data to extrapolate biomass estimates to unfished areas.

Extrapolation of biomass estimates from the fished area to the entire bank could overestimate current biomass levels on the bank as habitat suitability data is unavailable and the analysis would assume uniform distribution. Setting harvest levels based on biomass estimates in unfished areas where no current data exists and where fishable densities may be low increases the likelihood that previously fished areas may be depleted faster than they can be replenished. Whether there is a large amount of clam biomass present in unfished areas of the bank that has not been considered was disputed by some meeting participants throughout the meeting.

It was asked if the assumptions of a surplus production model were met for Arctic Surfclam. Five spatial assessment areas were developed to facilitate biomass modelling and were delineated by grouping contiguous clam beds. Fitting the model to five smaller areas instead of one larger area provided the ability to account for spatial variability in parameter estimates, including the realistic propagation of credible errors, and thus provided a stable architecture to model population demographics. The outer bounds of the spatial management area were discussed. It was clarified that the outer bounds of the spatial management area are defined by the 100 m contour line. It was suggested that the stock be defined by the area fished rather than the contour line. Concern was expressed that the whole bank was not being considered in the assessment and if the stock is defined by fished area, the boundaries will continue to change as

new areas are fished. If the fished area is used to define the management area, it was suggested that the stock may need to be re-stratified as required based on changes to the fishery footprint.

It was suggested that all figures and tables captions indicate that the data presented only pertains to fished areas and not the entire bank.

There was considerable discussion regarding the need for a fishery-independent survey for the whole bank. It was agreed that survey data is required to update estimates of fishable biomass in the unfished portion of the bank and provide a stock biomass estimate. It was proposed that a stratified survey design that considers habitat suitability be used in future assessments.

HABITAT SUITABILITY MAPPING

Presentation: Hubley et al. 2017. Assessment of the Arctic Surfclam (*Mactromerus polynyma*) stocks on Banquereau and Grand Banks. CSAM Working Paper 2017/04.

Science Lead: C. Brown
Rapporteur: L. Bennett

Presentation Summary

Dr. Craig Brown (NSERC Industrial Research Chair in Ocean Mapping at the Nova Scotia Community College) presented the preliminary results from a collaborative research project underway between Clearwater Seafoods and NSCC. The presentation highlighted methodology that has been developed for modelling species distributions on the seafloor from underwater imaging surveys and multibeam echosounder data. The presentation included results from species distribution modeling work undertaken on Banquereau Bank by NSCC from multibeam sonar and clam harvest data. The research work has generated predicted maps of habitat suitability for Surfclam over a portion of the bank (where multibeam data exists). These maps are currently being used by the licence holder in their harvest operation. The presentation discussed how these data could be used to inform stock assessment for clam in the future.

Discussion

Habitat Suitability Mapping

The accuracy of the backscatter was questioned. The same system is used to map the whole area and when backscatter results are compared to photographs of the area, the system is considered to have a high predictive ability.

The fished area polygons identified using VMS density showed a high degree of overlap with areas of high habitat suitability based on the independent analysis data. However, the use of fine scale information regarding habitat does not consider other environmental factors, such a current or temperature that could be contributing to the location of suitable habitat. Participants agreed that further analyses that explore the relationship between habitat suitability and VMS density or clam density, and the integration of habitat suitability models into the clam assessment methods, is required.

The presented habitat suitablity is a probability measure, not an index, with equidistant bin cut-offs for high, medium, and low-quality habitat primarily defined by bottom hardness. The high-resolution habitat suitability maps confirmed the patchiness of clam distribution over the bank. It was recommended that bin cut-off points used to define high, medium, and low-quality habitat be examined further. There was general agreement that the habitat suitability map areas

indicating high-quality habitat correspond with areas of high clam density; however, there was disagreement on industry access to low density areas and whether there are sufficient clam densities in areas of low and medium habitat suitability to make them viable. Estimating clam biomass outside of the fished area was cautioned against until the accuracy of the habitat suitability measures in relation to Surfclam density are confirmed (ground-truthed). Moving forward, it was proposed the data from the 2004 and 2010 surveys be superimposed on the habitat suitability map to inform the habitat suitability model and that biomass estimates from previous surveys be re-calculated by weighting the estimates against habitat suitability to reduce the uncertainty of the estimate.

Spatial Production Model and Reference Points

The use of a beta distribution as an informative prior to calculate catchability (q) was questioned. Although different habitats are present, it was assumed the dredged operated similarly between them. It was suggested that a more neutral distribution be considered. Given the changes in fishing, a time varying catchability, which would require auxiliary information to inform it, may be more appropriate. Due to increasing efficiency in the fishery, catchability is not constant over time and temporal variability should be addressed. The prior for intrinsic population growth (r) was considered too informative and it was suggested an alternative be considered. The prior on r was constructed by estimating the mean and standard deviation of r across all areas. The estimate of the standard deviation was quite small, which resulted in an informative prior on r. An informative prior was placed on the standard deviation of r in an attempt to make the prior on r less informative.

There was a discussion on the MSY-based reference points calculated from estimates of intrinsic population growth, r, and carry capacity, k, from the surplus production model. The biological reference points B_{MSY} and F_{MSY} were used to calculate the default 0.8 and 0.4 B_{MSY} typically used to define the limit reference point and upper stock reference in the precautionary approach. There was concern that estimates of k and r could be confounded in the SPM. Particularly, there was concern that low estimates of k and correspondingly high estimates of r could potentially lead to unreliable reference points. It was clarified that k is scaled to habitat, which are static, and the reference points reflect the ratios in scaling. Phase plots displaying the B_{MSY} and removal reference levels of $0.5F_{MSY}$ and 0.33M indicate that biomass declines when F is above $0.5F_{MSY}$; therefore, a F_{MSY} of 0.9M appears overestimated and is greater than any observed F levels. Biomass declines have been observed at current exploitation rates, industry confirmed that this is consistent with their experience on the water. Biomass estimates of Arctic Surfclam were considered to be in the Healthy Zone in relation to each of the different proposed reference points. A removal reference of $0.5F_{MSY}$ was proposed as an intermediate value.

It was recommended that recovery rates should be considered for future research.

The current frequency of stock assessments for Arctic Surfclam on Banquereau Bank was considered low. A five year assessment schedule, with triggers for an earlier than scheduled assessment, was proposed and accepted by meeting participants. Proposed triggers included: issues with the SPM, median biomass estimate of fishable biomass for all five areas approaching the cautious zone, or a 30% increase in the fishery footprint. During interim years, a Science Response Report will be produced showing the time series of catch, effort, fishery footprint, catch per unit effort, results of the spatial production models, and the status of those results in relation to the reference points. A new framework would be triggered when there is new information that would change the assessment approach such as new estimates from a fishery independent survey, additional habitat suitability information, or new analysis on an unfished area is completed.

DOCUMENTS

It was agreed Hubley et al. (WP 2017/05) should be published as a Research Document. A Science Advisory Report (SAR) will also be published. A revised SAR will be sent to meeting participants after the meeting for review and finalization. All meeting products will be published on the Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat's (CSAS) Website as they become available.

This Proceedings Document constitutes the record of meeting discussions, recommendations, and conclusions.

During the meeting there was no consensus on the provision of a biomass estimate for the unfished portion of the Bank and the use of catch per unit effort to estimate fishable biomass. Following the meeting, a minority report, a description of the dissenting view of Dave Kulka, representing Ocean Choice International, was submitted and is included as Appendix 4 of this Proceedings Report.

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APPENDICES

APPENDIX 1: LIST OF MEETING PARTICIPANTS

Name	Affiliation
Bennett, Lottie	DFO Maritimes / Centre for Science Advice
Bertram, Doug	Full Bay Scallop Association (FBSA)
Boyd, Catherine	Clearwater Seafoods
Brown, Craig	Nova Scotia Community College
Choi, Jae	DFO Maritimes / Population Ecology Division
Coffen-Smout, Scott	DFO Maritimes / Oceans and Coastal Management
Cook, Adam	DFO Maritimes / Population Ecology Division
Couture, John	Unama'ki Institute of Natural Resources (UINR)
Cox, Michael	KMK Negotiation Office (KMKNO)
Docherty, Verna	DFO Maritimes / Resource Management
Greenlaw, Michelle	DFO Maritimes / Coastal Ecosystem Division
Heaslip, Susan	DFO Maritimes / Population Ecology Division
Hubley, Brad	DFO Maritimes / Population Ecology Division
Kavanagh, Sana	Confederacy of Mainland Mi'kmaq (CMM)
Kulka, Dave	Ocean Choice International Inc.
Lowe, Jonathan	NS Dept. Fisheries and Aquaculture (NSDAF) / Marine
MacDonald, Carl	DFO Maritimes / Resource Management
Marentette, Julie	DFO National Headquarters
McIntyre, Tara	DFO Maritimes / Population Ecology Division
Mugridge, Adam	Louisbourg Seafoods Ltd.
Nasmith, Leslie	DFO Maritimes / Population Ecology Division
Nicholas, Hubert	Membertou First Nation / Fisheries
Penney, Christine	Clearwater Seafoods
Perrier, Erika	Atlantic Policy Congress of First Nations Chiefs Secretariat
Roddick, Dale	DFO Science Emeritus
Samson, Réal	Premium Seafoods Inc.
Sinclair, Mike	Louisburg Seafoods
Stanley, Ryan	DFO Science / Coastal Ecosystem Science
Sullivan, Loyola	Ocean Choice International Inc.
Worcester, Tana	DFO Maritimes / Centre for Science Advice

APPENDIX 2: TERMS OF REFERENCE

Stock Assessment of Arctic Surfclam

Regional Peer Review – Maritimes Region

April 20-21, 2017
Dartmouth, NS

Chairperson: Tana Worcester

Context

The Arctic Surfclam (*Mactromeris polynyma*) is a slow growing long-lived species found primarily in coarse sandy bottoms. In the western Atlantic, they occur from the Strait of Belle Isle to Rhode Island. The Arctic Surfclam fishery in the Canadian Atlantic operates on both the Scotian Shelf and the Grand Banks, with primary focus on Banquereau in recent years. The Scotian Shelf and Grand Banks offshore clam fisheries are managed under one plan, with the licence holder(s) having equal access to quotas in both areas through Enterprise Allocations.

Science surveys of Banquereau Arctic Surfclams were conducted in 2004 and 2010. Due to the large size of the Grand Bank, a scientific survey of Grand Bank Arctic Surfclam was conducted in three parts ending in 2009 (2006, 2008 and 2009) to assess the biomass of the stock in this area. A peer reviewed stock assessment of Grand Bank Arctic Surfclam was conducted in 2010 (DFO 2010), using an assessment approach similar to that developed for Banquereau. The Banquereau Arctic Surfclam stock was last assessed in 2011 (DFO 2012). An assessment framework for Arctic Surfclam on Banquereau and Sable banks was developed in 2007 (DFO 2007) and the methods of assessment for Banquereau were revised in 2016. A surplus production model and spatially disaggregated analysis was accepted as the new assessment approach at the 2016 assessment framework meeting.

In support of the decision-making for the 2018 fishery, DFO Maritimes and Fisheries and Aquaculture Management Branch have requested an assessment of resource status from DFO Maritimes Science.

Objectives

The objectives of this meeting are to:

- Present recent fisheries information for Banquereau and Grand Bank stocks, including:
  - Fishery Footprint
  - Catch per Unit Effort
  - Catch Size and Composition
- Evaluate the current stock status of the total fished area and the five proposed assessment areas on Banquereau.
- Evaluate reference points to be used in stock assessments and stock status updates of Surfclam on Banquereau.
- Present available information on habitat suitability.
- Develop the assessment schedule, including guidelines for monitoring of indicators and other events that would trigger an earlier than scheduled assessment.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Participation

- DFO Science, Ecosystem Management, Fisheries and Aquaculture Management, and Policy and Economics
- Aboriginal Communities/Organizations
- Fishing Industry
- Provincial representatives
- Academics
- Non-governmental organizations
- Other invited experts

References

DFO. 2007. Proceedings of the Maritime Provinces Regional Advisory Process on Assessment and Management Strategy Framework for Banquereau Arctic Surfclam and Ocean Quahogs on Sable Bank and in St. Mary's Bay. 17-18 January 2007; 4-5 April 2007. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2007/008.

DFO. 2010. Assessment of the Arctic Surfclam (*Mactromeris polynyma*) Stock on Grand Bank. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/063.

DFO. 2012. Assessment of the Arctic Surfclam (*Mactromeris polynyma*) Stock on Banquereau in 2010. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/068.

APPENDIX 3: MEETING AGENDA

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April 20-21, 2017
Bedford Institute of Oceanography
Dartmouth, NS

Chairperson: Tana Worcester

DRAFT AGENDA

DAY 1 (Thursday, April 20, 2017)

Time	Topic
09:00 – 09:15	Welcome and Introductions
09:15 – 09:45	Background, life history, ecosystem considerations, dredging impacts and by-catch
09:45 – 10:30	Data review: survey and fishery data
10:30 – 10:45	***Break*** *(Coffee/tea provided)*
10:45 – 12:00	Assessment: indicators, biomass estimates, stock status, spatial production model
12:00 – 13:00	***Lunch*** *(Not provided – cafeteria is on-site)*
13:00 – 14:00	Comparison of multibeam and VMS data
14:00 – 14:30	Evaluate reference points to be used in stock assessments and stock status updates of Surfclam on Banquereau
14:30 – 14:45	***Break*** *(Hospitality not provided)*
14:45 – 15:45	Assessment schedule, guidelines for monitoring of indicators, triggers for an earlier than scheduled assessment
15:45 – 16:00	Wrap-up

DAY 2 (Friday, April 21, 2017)

Time	Topic
09:00 – 09:30	Review of previous day
09:30 – 10:30	Review of Science Advisory Report
10:30 – 10:45	***Break*** *(Coffee/tea provided)*
10:45 – 11:45	Finalization of Science Advisory Report
11:45 – 12:00	Wrap-up

APPENDIX 4: MINORITY REPORT FROM DAVE KAULKA REPRESENTING OCEAN CHOICE INTERNATIONAL INC.

Normally, fish and invertebrate stocks are assessed based on fishery independent surveys that cover the full extent of the stock, in order to derive an estimate of total or spawning biomass. Those values can then be used to derive allowable catch for the entire stock. The USA, for example uses a random stratified survey in order to derive total and mature biomass and assess their surfclam stock over its entirety.

For this assessment, commercial CPUE extrapolated to the fishing footprint, amounting to 18% of the stock area has been used to derive an estimate of biomass. One of the reasons fishery dependent data are seldom used in the absence of independent surveys is that they are highly affected by the fishery influences not related to changes in stock biomass. In this case, the major influence is that it does not take into account the entire stock and is thus biased as an estimator of total biomass, and this bias may be substantial. Accounting for that unassessed biomass over 80% of the stock area should have been part of the assessment process. Past clam assessments did account for the entire stock area.

Clearly the vessel used to fish the clams target concentrations but it not clear if those targeted areas represent (near) 100% of the clam concentrations, as is implicitly assumed with the current assessment model. Conversely, there is substantial evidence of the presence of clam concentrations as seen in the past independent surveys (substantial catches outside of the footprint), from the new habitat suitability work (suitable areas for clams both inside and outside the footprint) and new areas fished in 2016 (commercially viable catch rates achieved outside of the previously footprint) that there is significant biomass excluded from the calculation of biomass with the current process. As is common commercial fishing practice, the clam vessel has returned year after year to the same fishing locations. Clearwater has not undertaken any exploratory fishing to determine if there are other commercially viable grounds, because they do not need to. They can take what they need, year after year without expending resources looking for new areas. Thus, a significant portion of the biomass is not accounted for in the assessment and resulting TACs.

As well, the 5 indices that were presented at this assessment showed that that portion of the stock within the footprint has fluctuated without trend. Thus, the stock is not too far away from virgin biomass, quite an unusual circumstance for an exploited stock. No quantitative information was presented to demonstrate how changes in technology might have influenced this trend although it was suggested that technology may influence catch rates.

Thus, there is a 6th as yet unfished area that has been excluded from the assessment of clams. DFO has declined to include this information in the estimate of biomass at this time.

It is requested that it be made clear in all documentation, the Res Doc and the Science Advisory Report that this process is an assessment of the biomass within the fished area only, constituting only 18% of the stock area. Thus, the approach used this time has changed the stock boundaries to where Clearwater has fished in the past. Should Clearwater in the future choose to fish new areas then those stock bounds will once again change: there will be no spatial consistency across time causing the results not to be comparable across years. This is a highly unusual and inappropriate situation, stock bounds dictated by changing commercial fishing locations.

A key research recommendation/trigger must be to conduct bank wide independent surveys, perhaps joint industry/DFO surveys, to determine not only what occurs both inside the footprint but elsewhere to ensure that exploitation of this valuable resource is at an appropriate level.

There is also a need to consider the Grand Bank resource as well, that has been largely ignored despite substantial catches in 2016. This must occur sooner rather than later.